Doi: 10.46858/VIMSJPT/2026/v8.i1/20-28
Vol 8(1), 2026 | pp. 20-28
ISSN: 2581-8821

VIMS Journal of Physical Therapy

ORIGINAL ARTICLE

Comparative Analysis of Resistance and Aerobic Training Effects on Balance Performance in Elderly Adults: A Quasi-experimental Study

Chaughule Yashodhan[1*] and P Manikandan[2]

[1]Department of Cardiovascular and Respiratory Physiotherapy, Rashtrasant Janardhan Swami College of Physiotherapy Kokamthan, (Maharashtra University of Health Sciences, Nashik) Kopargaon - 423601, Maharashtra, India; dr.yashodhanchaughule@gmail.com

[2]Department of Musculoskeletal Physiotherapy, Rashtrasant Janardhan Swami College of Physiotherapy Kokamthan, (Maharashtra University of Health Sciences, Nashik) Kopargaon - 423601, Maharashtra, India

Keywords: Aerobic Training, Balance, Geriatric, Impairments, Resistance Training

Manuscript Received: 15-04-2026
Manuscript Revised: 30-05-2026
Manuscript Accepted: 26-06-2026

How to cite this article: Chaughule Y, Manikandan P. Comparative Analysis of Resistance and Aerobic Training Effects on Balance Performance in Elderly Adults: A Quasi-experimental Study. VIMS J. Phys. Ther. 2026; 8(1):20-28.

Abstract

Background: Although both resistance training and aerobic training have been shown to improve physical function in older adults, comparative evidence on their effectiveness in improving balance among elderly individuals with balance impairments is limited. Therefore, this quasi-experimental study was conducted to compare the effectiveness of resistance training and aerobic training in improving balance in the geriatric population with balance impairments and to evaluate the magnitude of improvement achieved with each intervention. **Aim:** To compare the effectiveness of resistance training and aerobic training in improving balance among geriatric individuals with balance impairments. **Materials and Methods:** Ethical clearance was obtained from the IEC. Of 70 screened participants, 48 geriatric individuals with balance impairment were enrolled and allocated into Group A (Resistance Training, n = 24) and Group B (Aerobic Training, n = 24). Balance was assessed using the Berg Balance Scale, 2-Minute Step-in-Place Test, Arm Curl Test, and Chair Stand Test. Data were analyzed using IBM SPSS Statistics for Windows, Version 26.0. **Result:** The study found significant improvements in both resistance and aerobic training, improved balance outcomes in geriatric individuals with balance impairments. Berg Balance Scale and 2-Minute Step-in-Place Test scores were comparable between groups ($p > 0.05$), while Chair Stand and Arm Curl Test scores were significantly higher in the resistance training group ($p < 0.001$). Furthermore, a comparative analysis revealed comparable gains in balance performance between the resistance training and aerobic training interventions, suggesting similar effectiveness in improving balance outcomes among older adults with balance impairments. **Conclusion:** Both aerobic and

resistance training improved balance, endurance, and strength, but resistance training produced greater improvements in limb strength. Incorporating resistance exercises into geriatric rehabilitation may enhance physical function, reduce fall risk, and improve quality of life.

INTRODUCTION

Balance is defined as a person's ability to maintain their line of gravity within their Base of Support (BOS). It can also be described as the ability to sustain equilibrium where all forces acting on the body are counteracted, resulting in a stable system. The terms postural control, postural stability, and equilibrium are often used interchangeably with balance. In older adults, balance control tends to decline due to age-related physiological changes. Falls have become a significant public health concern among the elderly, and fear of falling is a major barrier to daily mobility and physical activity participation. The human postural and balance control system is challenged by our bipedal posture, which places considerable demands on several body systems to maintain stability during functional tasks.

Balance relies on complex, integrated interactions between sensory (vestibular, visual, and proprioceptive), motor, and cognitive systems. Proprioceptive input from joints, muscles, and skin communicates information about body position, pressure distribution, and environmental interactions. The vestibular system provides information on head position and acceleration, while the visual system contributes both environmental awareness and self-orientation sometimes termed exproprioception. Redundant sensory input from these systems allows for cross-verification and compensation when one subsystem fails. The Central Nervous System (CNS) integrates these inputs and determines appropriate motor outputs, which are executed by the musculoskeletal system to maintain posture and balance[1,2].

The prevalence of balance problems increases with age: about 13% at age 65, 35% at age 75, and up to 46% by age 85[3]. Impaired balance is one of the leading causes of falls in older adults, which can lead to injury, disability, dependence, and even mortality[4]. Sarcopenia age-related loss of muscle mass and function-is a major contributor to falls, and its consequences make it a key public health issue[5]. Falls are positively associated with morbidity and mortality and negatively associated with functional independence[6].

Gait abnormalities in older adults are often linked to degeneration in higher-order CNS structures such as the motor cortex, basal ganglia, and frontal-subcortical circuits, despite the involvement of lower centers like the cerebellum and spinal cord in locomotion. These higher centers play a role in adjusting postural responses based on context and environment. The cerebellum and vestibular system, especially via the vestibulospinal tract, are central to adaptive postural control. Without cerebellar input, postural responses are poorly graded, impairing muscle co-activation and increasing fall risk[7,8].

Exercise is a well-established intervention to mitigate age-related functional decline. Fall prevention programs consistently highlight the importance of balance and strength training. Such exercises train the body to control its center of gravity within the BOS, reducing postural sway and fall risk. Improved neuromuscular coordination through targeted training is a key mechanism behind balance enhancement[9]. Aerobic exercise involves rhythmic, repetitive movements requiring oxygen consumption, improving cardiovascular and muscular endurance. On the other hand, resistance training or strength training involves exercises where muscles contract against external resistance (*e.g.*, weights, bands), improving muscular strength and functional ability. Resistance training is considered anaerobic in nature[10].

Resistance training enhances muscle hypertrophy, particularly in type II muscle fibres, which are essential for rapid responses and postural corrections. These improvements contribute to enhanced muscle power, joint stability, and balance control[11]. According to Chou et al., resistance training can counteract frailty

and improve muscle strength in older adults, which is essential in fall prevention[12].

Simple, low-impact resistance band exercises are suitable for frail older adults and can be performed seated. These exercises are effective in improving balance and reducing fall risk, even among individuals with physical limitations[13]. According to Yeun, resistance band exercises can be a safe, accessible strategy to maintain muscle strength and balance in the elderly[14]. Aerobic capacity, measured as peak VO2, declines with age. A minimum aerobic capacity of 18 ml/kg/min is required for independent living, while the average capacity in octogenarian women is often between 12-15 ml/kg/min-close to the dependency threshold[15]. Regular cardiovascular exercise, such as walking, helps maintain aerobic capacity, delay disability, and improve health-related quality of life[16]. Aerobic training also preserves mitochondrial and motor unit function and may attenuate sarcopenia.

Additionally, both resistance and aerobic exercise contribute to improved bone mineral density by increasing osteoblast activity through mechanical loading. A Cochrane review found that walking increased bone mineral density by 1.3% at the hip and 0.9% at the spine in postmenopausal women[17]. Falls continue to be one of the most common causes of injury and hospitalization in the elderly. According to the CDC, one-third of community-dwelling adults over 65 fall annually, with over 10% resulting in serious injury[18]. Based on the existing evidence, there is limited comparative research evaluating the relative effectiveness of resistance training and aerobic training on balance performance in elderly adults with balance impairments. Therefore, the present quasi-experimental study aims to investigate and compare the effectiveness of resistance training and aerobic training in improving balance among the geriatric population with balance impairments. Specifically, the study seeks to evaluate the effects of resistance training and aerobic training on balance outcomes and compare the magnitude of balance improvement achieved with each intervention.

MATERIALS AND METHODS

Ethical clearance was obtained from Institutional Ethical Committee of Rashtrasant Janardhan Swami College of Physiotherapy, MUHS. Total number of participants screened were 70, among them 48 were included in the study. Participants above 60 years of age (Geriatric Population) with balance impairment and who were will to participate were included in the study. Participants who were on medications which carry the risk of causing fall, Neurological condition and any peripheral neuropathy of lower limb were excluded for this study. The participants were selected randomly from Community Department of Sant Janardhan Swami Hospital voluntarily. After taking written informed consent form all the 70 participants, only 48 participants were randomly selected for further participation in this study on the basis of inclusion criteria. All these 48 Participants were divided into 2 groups i.e., Resistance Training Group (Group A) (n=24) and Aerobic Training Group (Group B) (n=24). Group A was given Resistance Training Exercise and Group B was given Aerobic Training Exercises that is Progressive resisted strength training for hip flexors, hip extensors, hip abductors, knee flexors, knee extensors, ankle dorsiflexors, ankle plantar flexors for Resistance training and Stationary Cycling for Aerobic training. All the instructions were given verbally, provided demonstration, and guided through a single practice trail. The participants were given exercise regimen and administered to perform for 25-30 minutes per day for 3 days in a week for 4 weeks. Balance, Aerobic capacity, Upper extremity strength, Lower extremity strength were measured using Berg balance Scale, 2 min step in place test and Arm Curl test, Chair stand test pre and post completion of intervention.

Outcome Measures

2 Min Step in Place Test

The 2-Minute Step-in-Place Test is a simple and effective measure of aerobic endurance, particularly suitable for older adults. To perform the test, the individual begins

by standing next to a wall where a mark is made midway between the patella (kneecap) and iliac crest (hip bone) his serves as the minimum height the knees must reach during stepping. The participant then marches in place for 2 minutes, lifting their knees to at least the height of the marked midpoint. The arms may swing naturally, and the participant is allowed to rest if needed but is encouraged to resume as soon as possible. Only the number of times the right knee reaches the required height is counted. The total score is the number of correct steps completed in 2 minutes. This test helps assess cardiovascular fitness and endurance and can be safely performed in clinical and home settings with minimal equipment[19].

Arm Curl Test

The Arm Curl Test is a commonly used assessment to measure upper body strength and endurance, particularly of the biceps muscles, in older adults. To perform the test, the participant sits upright in a chair without armrests, with feet flat on the floor and back straight. They hold a dumbbell in their dominant hand 5 pounds (2.3 kg) for women and 8 pounds (3.6 kg) for men. Starting with the arm fully extended alongside the body, the participant curls the weight by bending the elbow, bringing the hand toward the shoulder, then lowers it back to the starting position. This movement is repeated as many times as possible in 30 seconds, using proper form and full range of motion. The opposite hand may rest on the thigh for support but should not assist. The total number of correctly completed curls within the time limit is recorded as the score. This test is part of the Senior Fitness Test and is used to evaluate functional upper body strength essential for daily tasks such as lifting and carrying[19].

Berg Balance Scale

The Berg Balance Scale (BBS) is a widely used clinical tool designed to assess static and dynamic balance abilities in older adults and individuals with balance impairments. It consists of 14 functional tasks, each focusing on different aspects of balance such as sitting, standing, reaching, turning, and transferring positions. Examples include standing unsupported, reaching forward, standing on one leg, and retrieving an object from the floor. Each task is scored on a 5-point ordinal scale ranging from 0 (unable to perform) to 4 (normal performance), with a maximum total score of 56. A higher score indicates better balance. Scores below 45 are generally associated with a greater risk of falls. The BBS is simple to administer, requires minimal equipment (a chair, stopwatch, and a step), and takes about 15-20 minutes to complete. It is commonly used in geriatrics, stroke rehabilitation, and various neurological and orthopaedic conditions to evaluate fall risk and guide intervention planning[20].

Chair Stand Test

The Chair Stand Test is used to assess lower limb strength and functional ability in older adults. To perform the test, the participant sits in the middle of a standard armless chair placed against a wall for safety, with feet flat on the floor and arms crossed over the chest. On the command "Go," the participant rises to a full standing position and then returns to a seated position as many times as possible within 30 seconds. The arms must remain crossed throughout the test. A full repetition is only counted when the individual fully stands and sits back down correctly. If the participant is more than halfway up at the 30-second mark, that final attempt is also counted. The total number of complete stands performed in 30 seconds is the final score. This test is simple, requires minimal equipment, and provides a reliable indicator of lower limb muscle strength and endurance in the geriatric population[21].

Exercises

Group A = Warm up + Resistance Training + Cool Down

Group B = Warm up + Aerobic Training + Cool Down

Statistical Analysis

Statistical analysis was performed using IBM SPSS Statistics for Windows, Version 26.0.

Table 1. Exercise program

Protocol and Progression					
Exercises	**Exercise Progression Step**	**Position**	**Contraction duration**	**Volume of Each Exercise**	**Frequency**
1. Warm Up	-	-	10 minutes	-	-
2. Aerobic Training • Stationary Cycling	-	High Sitting	15 minutes	2 sets	3 times a week Monday Wednesday Friday
3. **Resistance Training** Progressive resistance training Hip Flexors, Extensors, Hip Abductors • Squats • Lunges • Hip Abduction Knee Flexors and Extensors • Leg Curls • Leg extensions Ankle Dorsiflexors and Plantarflexors • Leg raise Toe raise					3 times a week Monday Wednesday Friday
	Week 1 and 2	Standing	No hold	3 sets 10 reps	
	Week 3 and 4	Standing	No hold	3 sets 10 reps	
	Week 5 and 6	Standing	No hold	3 sets 10 reps	
	Week 7 and 8	Standing	Hold	3 sets 10 reps	
4. Cool Down	-	-	10 minutes	-	-

RESULTS

Total 70 participants were screened for the eligibility and 48 subjects were included as per the inclusion exclusion criteria. Demographic data is shown in Table 1. The data was recorded from the described test and Statistical analysis was carried out utilizing INSTAT software, Within Group analysis was done using Paired t- test and participants in Group A demonstrated significant statistical difference $p < 0.001$ increase in Balance, 2 min step in place, Chair stand test, Arm curl test. In terms of Mean ± SD, Balance increased from 31.21±4.47 to 50.71±1.94, 2 min step in place increased from 71.96±5.43 to 109.88±5.05, Chair stand test increased from 8.78±1.24 to 21.54±1.22 and Arm curl test increased from 12.48 ± 1.22 to 21.71±1.02 is shown in Table 2. Participants in Group B also demonstrated significant statistical difference $p < 0.001$ increase in ±Balance, 2 min step in place, Chair stand test, Arm curl test. In terms of Mean ± SD, Balance increased from 30.08±5.06 to 50.13±2.22, 2 min step in place increased from 72.96±6.62 to 111.71±4.01, Chair stand test increased from 10.04±1.55 to 18±0.88 and Arm curl test increased from 14.63 ± 1.24 to 17.42±2.65 is shown in Table 3. Between Group analysis was done using Unpaired t- test No statistically significant difference ($p > 0.05$) in Balance and 2 min step in place test Group A. Balance increased from 31.21±4.47 to 50.71±1.94 as compared to group B 30.08±5.06 to 50.13±2.22 with mean difference of 0.58. 2 min step in place increased from 71.96±5.43 to 109.80±5.05 as compared to group B 72.96±6.62 to 111.71±4.0 with mean difference of 1.91. Chair stand test increased from 8.78±1.24 to 21.54±1.22 as compared to group B 10.04±1.53 to 18±0.88 with mean difference of 3.54. Arm curl test increased from 12.48±1.22 to 21.71±1.02

as compared to group B 14.63±1.24 to 17.42±2.65 with mean difference of 4.29 shown in Table 4.

Table 2. Demographic data of subjects

Sr. No	Group	Gender	Participants	Mean Age in Years
1	A	Male	16	21.77
		Female	5	20.89
2	B	Male	17	22.3
		Female	4	21.88

DISCUSSION

The present study aimed to compare the effectiveness of two different exercise interventions on functional fitness outcomes among elderly individuals, including balance, endurance (2-minute step test), lower limb strength (chair stand test), and upper limb strength (arm curl test). A total of 48 participants were assigned to two groups (n=24 each). Both groups showed significant improvements in all measured outcomes within the group ($p \leq 0.001$), as revealed by paired t-tests. However, between-group analysis via

Table 3. Within group analysis (Group A)

Group A	Mean±SD		T Value	P Value	Significance
	Pre	Post			
Berg Balance Scale	31.21±4.47	50.71±1.94	20.95	<0.0001	Extremely Significant
2 Min Step in Place Test	71.96±5.43	109.88±5.05	25.04	<0.0001	Extremely Significant
Chair Stand Test	8.78±1.24	21.54±1.22	35.44	<0.0001	Extremely Significant
Arm Curl Test	12.48 ± 1.22	21.71±1.02	25.15	<0.0001	Extremely Significant

Table 4. Within Group Analysis (Group B)

Group B	Mean±SD		T Value	P Value	Significance
	Pre	Post			
Berg Balance Scale	30.08±5.06	50.13±2.22	22.02	<0.0001	Extremely Significant
2 Min Step in Place Test	72.96±6.62	111.71±4.01	39.98	<0.0001	Extremely Significant
Chair Stand Test	10.04±1.55	18±0.88	22.85	<0.0001	Extremely Significant
Arm Curl Test	14.63 ± 1.24	17.42±2.65	14.98	<0.0001	Extremely Significant

Table 5. Comparison between the group analysis post assessment mean value

	Groups	Post Intervention (Mean±SD)	Mean Difference	T Value	P Value	Significance
Berg Balance Scale	A	50.71±1.94	0.58	0.955	0.3441	Not Significant
	B	50.13±2.22				
2 Min Step in Place Test	A	109.88±5.05	1.91	1.393	0.1702	Not Significant
	B	111.71±4.01				
Chair Stand Test	A	21.54±1.22	3.54	11.54	<0.001	Statistically Significant
	B	18±0.88				
Arm Curl Test	A	21.71±1.02	4.29	7.40	<0.001	Statistically Significant
	B	17.42±2.65				

unpaired t-tests revealed that Group A showed greater improvements in chair stand and arm curl tests, while no significant difference was found in berg balance scale and 2-minute step test between groups ($p > 0.05$).

Improvement in balance observed in both groups aligns with previous studies demonstrating that regular resistance and functional training enhance postural control through neuromuscular adaptations and improved sensory integration[1,2]. The mean balance score increased significantly from pre- to post-intervention in both groups, which is consistent with findings by Granacher *et al.*, who observed marked improvements in postural stability in older adults following strength and coordination training[9].

The significant increase in the 2-minute step test scores in both groups reflects improved cardiovascular endurance. This is in agreement with research by Fleg *et al.,* which reported that even moderate aerobic exercise can enhance oxygen uptake capacity and delay aerobic decline in the elderly[15]. However, the between-group comparison did not show statistical significance (mean difference = 1.91, $p > 0.05$), suggesting that both intervention protocols were comparably effective for aerobic endurance.

A more pronounced improvement in chair stand test and arm curl test was seen in Group A, with mean differences of 3.54 and 4.29, respectively. This suggests that the exercise program followed by Group A may have placed greater emphasis on muscle strengthening, particularly in type II muscle fibers, which are essential for explosive movements and are prone to age-related atrophy[22]. This is supported by the work of Villare and Aguirre, who found that targeted resistance training can substantially enhance lower and upper limb muscle strength in older adults[23]. The use of resistance bands and functional training, as incorporated in Group A's protocol, is considered a safe and effective intervention for frail elderly individuals, improving muscle mass, neuromuscular coordination, and functional outcomes while reducing fall risk[25]. This mirrors findings from Yeun *et al.*, who emphasized the effectiveness of seated resistance training in improving physical performance in physically limited older adults[14]. These findings highlight the importance of incorporating structured strength training in elderly rehabilitation programs. While both aerobic and resistance exercises are beneficial, resistance training appears to yield superior gains in muscular strength and functional independence.

In the present study, within the group analysis showed significant difference across all outcomes in group a and group b but the post-intervention between the group comparison showed no significant difference for the Berg Balance Scale ($p = 0.3441$) and the 2-Minute Step Test ($p = 0.1702$). This finding suggests that both exercise interventions were similarly effective in improving balance and functional endurance among older adults. Resistance training enhances lower-limb muscle strength, proprioception, and neuromuscular control, whereas aerobic training improves cardiovascular fitness, gait efficiency, and dynamic postural stability. These complementary physiological adaptations may have resulted in comparable improvements in balance performance, thereby producing no significant between-group differences. Furthermore, the relatively short intervention duration (8 weeks), moderate sample size ($n = 24$ per group), and good baseline functional status of participants may have limited the ability to detect small differences between the interventions. The Berg Balance Scale is also known to exhibit a ceiling effect in higher-functioning older adults, which may reduce its sensitivity to distinguish subtle improvements after exercise training[24,25].

Implication to Practice

Clinician shall implement resistance training and aerobic training in getriatric population with balance impairments.

Limitations

- Small sample size
- Short duration of intervention conducted only for 8 weeks, may not allow for the comprehensive understanding of long term effects of resistance training and aerobic training on balance outcomes in geriatric population
- Study was conducted specifically in Kopargaon, Ahilyanagar, which may not fully represent the broader demographic and cultural variability

present in geriatric population with balance impairments. This could affect the applicability of the findings to other regions or ethnic groups

Future Scope

- Further studies can be done in large samples and for elderly individuals with balance impairments
- These findings are generalizable to a elderly individuals. Future study is warranted in clinical populations who have clinical conditions with associated age related conditions such as Osteoarthritis, Chronic obstructive pulmonary disease, Ischemic/Coronary heart disease and Hypertension

CONCLUSION

The study concludes that both aerobic and resistance-based training programs significantly improve balance, cardiovascular endurance, and muscular strength in the elderly population. While both intervention groups showed notable within-group improvements in all measured outcomes, the between-group comparison revealed that Group A, which incorporated a greater emphasis on resistance training, achieved superior gains in lower and upper limb strength, as demonstrated by greater improvements in the chair stand and arm curl tests. These results highlight the importance of incorporating structured resistance training alongside aerobic activity in geriatric rehabilitation programs to maximize functional capacity and reduce the risk of falls and improves balance in elderly. Implementing such targeted exercise interventions can significantly enhance the quality of life, independence, and physical performance in older adults and improve balance.

Institutional Ethical Approval

Approved with Ethical letter number MUHS/RJSCOPT/IEC/2025/74.

REFERENCES

1. Shumway-Cook A, Woollacott MH. Motor Control: Translating Research into Clinical Practice. 4th Edition. Philadelphia: Lippincott Williams and Wilkins. 2012.
2. Horak FB. Postural orientation and equilibrium: what do we need to know about neural control of balance to prevent falls? Age Ageing. 2006; 35(2):ii7-ii11. https://doi.org/10.1093/ageing/afl077 PMid:16926210 PMCid: PMC7857621.
3. Maki BE, Holliday PJ, Topper AK. A prospective study of postural balance and risk of falling in an ambulatory and independent elderly population. J Gerontol A Biol Sci Med Sci. 1994; 49(2):M72-M84. https://doi.org/10.1093/geronj/49.2.M72 PMid:8126355.
4. Rubenstein LZ. Falls in older people: epidemiology, risk factors and strategies for prevention. Age Ageing. 2006; 35(suppl_2):ii37-ii41. https://doi.org/10.1093/ageing/afl084 PMid:16926202.
5. Rosenberg IH. Sarcopenia: origins and clinical relevance. J Nutr. 1997; 127(5):990S-991S. https://doi.org/10.1093/jn/127.5.990S PMid:9164280.
6. Tinetti ME, Speechley M, Ginter SF. Risk factors for falls among elderly persons living in the community. N Engl J Med. 1988; 319(26):1701-1707. https://doi.org/10.1056/NEJM198812293192604 PMid:3205267.
7. Keshner EA, Cohen H. Current concepts in the clinical assessment of vestibular disorders. Arch Phys Med Rehabiltation. 1989; 70(3):186-199.
8. Nutt JG, Horak FB. Postural dysfunction in Parkinson's disease: A review. Mov Disord. 2004; 19(5):520-530.
9. Granacher U, Muehlbauer T, Gollhofer A. An overview of balance and strength performance capacity in healthy older adults. Aging Clin Exp Res. 2012; 24(5):451-458. https://doi.org/10.1155/2012/708905 PMid:22315687 PMCid: PMC3270412.
10. American College of Sports Medicine. ACSM's Guidelines for Exercise Testing and Prescription. 10th ed. Philadelphia: Wolters Kluwer. 2018.
11. Hunter GR, McCarthy JP, Bamman MM. Effects of resistance training on older adults. Sports Med. 2004; 34(5):329-348. https://doi.org/10.2165/00007256-200434050-00005 PMid:15107011.
12. Chou CH, Hwang CL, Wu YT. Effect of exercise on physical function, daily living activities, and quality of life in the frail older adults: A meta-analysis. Arch Phys Med Rehabilitation. 2012; 93(2):237-244. https://doi.org/10.1016/j.apmr.2011.08.042 PMid:22289232.
13. Villareal DT, Aguirre L, Gurney AB, et al. Aerobic or resistance exercise, or both, in dieting obese older adults. N Engl J Med. 2017; 376(20):1943-1955. https://doi.org/10.1056/NEJMoa1616338 PMid:28514618 PMCid: PMC5552187.

14. Yeun YR. The effect of resistance band exercise on balance and gait function in the elderly. J Phys Ther Sci. 2017; 29(10):1824-1827. https://doi.org/10.1589/jpts.29.1695 PMid:28932015 PMCid: PMC5599848.
15. Fleg JL, Morrell CH, Bos AG, *et al.* Accelerated longitudinal decline of aerobic capacity in healthy older adults. Circulation. 2005; 112(5):674-682. https://doi.org/10.1161/CIRCULATIONAHA.105.545459 PMid:16043637.
16. Nelson ME, Rejeski WJ, Blair SN, *et al.* Physical activity and public health in older adults. Med Sci Sports Exercise. 2007; 39(8):1435-1445. https://doi.org/10.1249/mss.0b013e3180616aa2 PMid:17762378.
17. Bonaiuti D, Shea B, Iovine R, *et al.* Exercise for preventing and treating osteoporosis in postmenopausal women. Cochrane Database Systemic Review. 2002; (3):CD000333. https://doi.org/10.1002/14651858.CD000333 PMid:12137611.
18. Centers for Disease Control and Prevention. Falls among older adults: an overview. 2008.
19. Rikli RE, Jones CJ. Senior Fitness Test Manual. 2nd Edition. Champaign (IL): Human Kinetics. 2013.
20. Berg KO, Wood-Dauphinee SL, Williams JI, Maki B. Measuring balance in the elderly: Validation of an instrument. Can J Public Health. 1992; 83(Suppl 2):S7-S11.
21. Jones CJ, Rikli RE, Beam WC. A 30-s chair-stand test as a measure of lower body strength in community-residing older adults. Res Q Exerc Sport. 1999; 70(2):113-119. https://doi.org/10.1080/02701367.1999.10608028 PMid:10380242.
22. Lexell J. Human aging, muscle mass, and fiber type composition. J Gerontol A Biol Sci Med Sci. 1995; 50(Spec Issue):11-16. https://doi.org/10.1093/gerona/50A.Special_Issue.11 PMid:7493202.
23. Villare F, Aguirre LE. Resistance training and healthy aging. Practical Guide to Exercise Physiology. Human Kinetics. 2015. pp. 211-222.
24. Sherrington C, Fairhall NJ, Wallbank GK, Tiedemann A, Michaleff ZA, Howard K, *et al.* Exercise for preventing falls in older people living in the community. Cochrane Database Syst Rev. 2019; 1(1):CD012424. https://doi.org/10.1002/14651858.CD012424.pub2 PMid:30703272.
25. American College of Sports Medicine. ACSM's Guidelines for Exercise Testing and Prescription. 11th Edition. Philadelphia: Wolters Kluwer. 2021.
26. Berg KO, Wood-Dauphinee SL, Williams JI, Maki B. Measuring balance in the elderly: Validation of an instrument. Can J Public Health. 1992; 83(Suppl 2):S7-S11.
27. Wolf SL, Sattin RW, O'Grady M, Richardson S. A standardized exercise program for elderly persons to reduce fall risk. J Gerontol A Biol Sci Med Sci. 2003; 58(7):M618-M624.
28. Centers for Disease Control and Prevention. Falls among older adults: an overview. 2008.
29. Lexell J. Human aging, muscle mass, and fiber type composition. J Gerontol A Biol Sci Med Sci. 1995; 50(Spec Issue):11-6. https://doi.org/10.1093/gerona/50A.Special_Issue.11 PMid:7493202.
30. Villare F, Aguirre LE. Resistance training and healthy aging. Practical Guide to Exercise Physiology. J Hum Kinet. 2015. pp. 211-222.
31. Wolf SL, Sattin RW, O'Grady M, Richardson S. A standardized exercise program for elderly persons to reduce fall risk. J Gerontol A Biol Sci Med Sci. 2003; 58(7):M618-M624.